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ARMY AVIATION TEST BOARD FORT RUCKER ALA  
SERVICE TEST AND UNIVERSAL HELICOPTER CARGO HOOK, 6,000-POUND C--ETC(U)  
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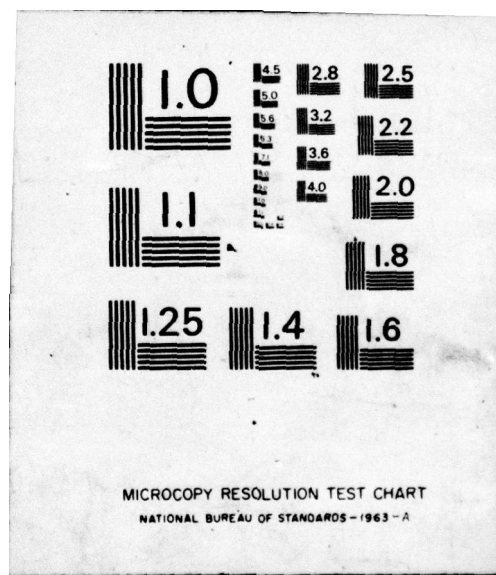
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DEPARTMENT OF THE ARMY  
UNITED STATES ARMY AVIATION TEST BOARD  
Fort Rucker, Alabama 36360

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SUBJECT: US Army Aviation Test Board Report of Test, USATECOM  
Project No. 4-3-7380-04, Service Test of Universal  
Helicopter Cargo Hook, 6,000-Pound Capacity

TO: President  
US Army Airborne, Electronics,  
and Special Warfare Board  
Fort Bragg, North Carolina 28307

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Forwarded herewith is subject report.

*Raymond E. Johnson*  
RAYMOND E. JOHNSON  
Colonel, Artillery  
President

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## SECTION 2 - DETAILS OF TESTS

### 2.1. INTRODUCTION.

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### 2.9. TEST NO. 8 - SUITABILITY OF THE UNIVERSAL HELICOPTER CARGO HOOK.

#### 2.9.1. Objective.

To determine the suitability of the Universal Cargo Hook for use with the UH-1D Helicopter.

#### 2.9.2. Method.

→ A number of external loads varying in weight (up to 4,000 pounds), size, and aerodynamic characteristics were lifted, flown, and released using the UH-1D Helicopter equipped with the standard cargo hook and the Universal Cargo Hook. All loads were released using the electrical release switches and then the manual cargo release pedals. Selected loads of various sizes and weights were released free-fall using the electrical release switches and then the manual cargo release pedals. Damage to, or problems encountered with, the standard cargo hook or the Universal Cargo Hook were recorded and reported. The time to effect cargo hookup, the difficulty of operation, and malfunctions were recorded for each load. Data were compiled on a comparative basis.

#### 2.9.3. Results.

2.9.3.1. Comparative data are presented in tabular form in appendix I.

2.9.3.2. The Universal Cargo Hook functioned satisfactorily during all operations. The three electrical and four mechanical release controls were suitable with respect to location, ease of operation, and reliability. The release of heavy loads in free-fall had no apparent damaging effect on the hook and the hook automatically closed and locked after each release. Only a few seconds were required for a ground crewman to engage a load to the hook of the hovering helicopter. An attachment ring was provided on the body of the hook for ground crew hookup of a parachute static line.

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2.9.3.3. The standard cargo hook functioned satisfactorily except for an occasional failure to relock automatically after a release of load under tension. (See appendix \_\_\_\_\_.) The two electrical release controls and the pilot's mechanical release were satisfactory; however, the emergency ground release was more difficult to operate than that of the Universal Cargo Hook because of less accessibility and the smaller size of the release lever on the hook. Ground crewmen had no more difficulty in engaging a load to the Universal Cargo Hook than to the standard cargo hook.

2.9.3.4. One problem existed in that the shear pin, which prevents rotation of the hook, in several instances broke when a load rotated in the helicopter's rotor wash. The shear pin is a part of the hook assembly and is common to both the standard hook and the Universal Cargo Hook. Its function is to prevent structural damage to the helicopter from the high forces generated by rotating loads.

#### 2.9.4. Analysis.

The Universal Cargo Hook was suitable for use with the UH-1D Helicopter and was superior to the standard cargo hook in the following respects:

- a. Automatic relocking was more reliable.
- b. Emergency ground release was easier to operate.
- c. Three additional release devices were provided.
- d. An attachment ring for parachute static lines was provided.

### 2.10. TEST NO. 9 - FLIGHT CHARACTERISTICS.

#### 2.10.1. Objective.

To determine the effect the Universal Cargo Hook has on the flight characteristics of the UH-1D Helicopter during external cargo operations.

#### 2.10.2. Method.

External loads varying in weight (up to 4,000 pounds), size, and aerodynamic characteristics were lifted, flown, and released using

the UH-1D Helicopter equipped with the standard cargo hook and the Universal Cargo Hook. The flight characteristics of the helicopter were qualitatively evaluated during hovering flight, takeoffs, straight climbs, climbing turns, straight and level flight, level turns, straight descents, descending turns, shallow approaches, and the termination of approaches to a hover.

#### 2.10.3. Results.

Flight characteristics of the UH-1D Helicopter transporting cargo externally with the Universal Cargo Hook were identical to the flight characteristics noted when the UH-1D Helicopter transported the same cargo externally with the standard cargo hook.

#### 2.10.4. Analysis.

Not applicable.

### 2.11. TEST NO. 10 - EXTERNAL CARGO OPERATIONS WITHOUT GROUND CREW.

#### 2.11.1. Objective.

To determine the suitability of the test item for external cargo operations without the assistance of a ground crew.

#### 2.11.2. Method.

Several external loads were configured with the sling target ring adapter installed vertically above the load. The pilot maneuvered the helicopter to engage the test item with the sling target ring adapter, with direction from a man on the ground, with direction from a crew chief on board, and with use of an externally installed rearview mirror. The positive cargo hook lock control was actuated and the load was lifted and flown with the helicopter. After terminating the approach at a hover, the pilot maneuvered the helicopter to release the load on a predesignated spot with direction from a man on the ground or the crew chief on board, or with use of the installed cargo rearview mirror. The ease or difficulty of external cargo pickup and release without a ground crew was qualitatively reported.



### 2.11.3. Results.

2.11.3.1. Descriptions of the various loads, method of hookup and release, and times required to complete each operation are contained in tabular form in appendix I.

2.11.3.2. Engagement of the sling target ring adapter with the cargo hook, the pilot referring only to the rearview mirror, required more pilot effort but was accomplished in nearly the same time as the engagement of similar loads with the aid of directions from a ground crewman. A crew chief on board the helicopter had difficulty seeing the cargo hook and this method of directing the pilot for load engagement was the least suitable.

2.11.3.3. External cargo loads that extended less than 10 feet below the helicopter were positioned and released by the pilot, using the rearview mirror, on a predetermined spot with no outside assistance. When taller loads were transported, the accuracy of load placement with respect to a predetermined spot decreased with the height of the load because of the detrimental effect on the depth perception of the pilot. When a crewman standing on the ground in front of or beside the helicopter directed the pilot with hand signals, the load was placed accurately. Oral directions given by a crewmember lying on the floor of the helicopter with his head in the open cargo door were satisfactory, but the results were less precise.

2.11.3.4. The use of the rearview mirror to position external loads on a predetermined spot was impractical because the terrain seen in the mirror was too far aft of the helicopter to be used as a reference. The mirror was useful in determining positive engagement and release of loads, in determining hook condition, and in verifying ground contact by noting the release of tension on the sling.

2.11.3.5. The average time required to move from a hovering position in front of the load and engage the sling with the Universal Cargo Hook was 12 seconds in calm air. In turbulent air, engagement of the target was more difficult and the time required ranged from 8 seconds to 75 seconds. Similar engagements using the standard cargo hook were slightly more difficult due to the smaller vertical dimension of the mouth of the hook and the occasional failure of the standard hook to close and lock automatically after a release of certain loads under tension. (See paragraph 2.11.3.7.)

2. 11. 3. 6. No significant difference existed when the times required to position or release the loads of the two hooks were compared.

2. 11. 3. 7. During the test period, the Universal Cargo Hook was operated \_\_\_\_\_ times, and no malfunctions occurred. During the same period, the standard hook was operated \_\_\_\_\_ times and malfunctioned six times by failing to close and lock.

2. 11. 4. Analysis.

The Universal Cargo Hook was suitable for external cargo operations without the assistance of a ground crew and was superior to the standard cargo hook with respect to ease of engagement and reliability.

2. 12. TEST NO. 11 - SUITABILITY OF INTERNAL MANUAL AND ELECTRICAL RELEASE CONTROLS.

2. 12. 1. Objective.

To determine the suitability of the manual and electrical release devices within the aircraft.

2. 12. 2. Method.

Each load carried on the Universal Cargo Hook was released by the electrical release switches located on each pilot's cyclic control grip and at the crew chief's station. Each load was also released by the manual mechanical release devices located at each pilot's feet and at the crew chief's position. Each load was released by a ground crewman using the mechanical release lever on the body of the hook. The number and type of loads released, the method of release, and related malfunctions were recorded.

2. 12. 3. Results.

2. 12. 3. 1. Data in tabular form are contained in appendix I.

2. 12. 3. 2. The Universal Cargo Hook was opened satisfactorily from the pilot, copilot, and crew chief stations by electrical and mechanical means, and by mechanical means from the ground.



2.12.3.3. The Universal Cargo Hook would not open without a load attached but opened satisfactorily when a \_\_\_\_\_ pound load was released. A minimum load of \_\_\_\_\_ pounds was needed to open the standard cargo hook.

2.12.3.4. Loads weighing up to 4,000 pounds were released during air delivery operations without adverse effect to the Universal Cargo Hook. A fixed attachment ring was provided on the body of the hook for ground crew hookup of the parachute static line.

2.12.3.5. Malfunction of a release device did not occur.

2.12.4. Analysis.

The manual and electrical release devices were suitable.

2.13. TEST NO. 12 - SUITABILITY OF HOOK CLOSURE WARNING LIGHT.

2.13.1. Objective.

To determine the suitability of the hook closure warning light at the pilot's station to indicate when the load-carrying beam of the hook is closed and positively locked.

2.13.2. Method.

The pilot observed the hook closure warning light after each hook engagement and release. False indications or malfunctions of the light were recorded.

2.13.3. Results.

2.13.3.1. Data in tabular form are contained in appendix I.

2.13.3.2. During the test period, \_\_\_\_\_ engagements and release operations were performed. There were no malfunctions or false indications of the warning light.

2.13.4. Analysis.

The hook closure warning light was suitable for the purpose of indicating that the cargo hook was closed and positively locked.

## 2. 14. TEST NO. 13 - SPECIAL AIRCREW TRAINING OR SKILLS.

### 2. 14. 1. Objective.

To determine if special training or skills are required for the helicopter crew to operate the Universal Cargo Hook.

### 2. 14. 2. Method.

During the test period, the project officer, pilots, and crew-members qualitatively compared the skills and training required for external cargo operations with the Universal Cargo Hook with those required for similar operations with the standard cargo hook. Emphasis was placed on those skills and training required for the pickup and release of external cargo loads without a ground crew.

### 2. 14. 3. Results.

2. 14. 3. 1. In addition to the training required for external cargo operations with the standard cargo hook, crew chief personnel operating the Universal Cargo Hook required a ten-minute briefing on the operation of the electrical and mechanical releases installed at the crew chief position. Precautionary measures to avoid inadvertent release of cargo being transported were stressed. No additional training for pilots was necessary.

2. 14. 3. 2. A pilot, inexperienced in the use of the rearview mirror, reached an acceptable degree of proficiency in unassisted engagements and release of small cargo loads in a half-hour practice period. Engagements of tall loads, where ground reference was less helpful, was more difficult; and the pilot required an extra half-hour of practice to become proficient. A pilot experienced in the use of the mirror had no difficulty in performing these operations with either cargo hook; however, the Universal Cargo Hook was superior to the standard cargo hook in ease of engagement and reliability. (See paragraph 2. 11. 3. 5.)

2. 14. 3. 3. The following techniques were used successfully by the pilot to engage the sling of the cargo with the hook, while using the rearview mirror.

a. Adjust the mirror to reflect the cargo hook and as much area below the hook as possible.



b. With the helicopter at a hover, check the positive locking light OFF.

c. Check the cargo hook arming switch ON.

d. Hover the helicopter so that the mirror is a foot or two in front of and above the cargo load sling.

e. Slowly move the helicopter forward until the mirror is behind the sling and then begin a slight descent until the sling becomes visible in the mirror. Move the helicopter right or left, with cyclic control, as indicated by the mirror image of the hook and the sling until engagement of the hook and the sling occurs. If engagement does not occur, repeat d and e.

f. Redirect attention from the mirror to the ground and halt the forward motion of the helicopter.

g. Check positive engagement of the sling and hook by reference to the mirror.

h. Slowly raise helicopter until all slack is removed from the cargo sling and helicopter is directly over the load.

i. Divert attention from mirror and raise the helicopter vertically until the cargo load is free of the ground.

#### 2.14.4. Analysis.

A small amount of additional training is required for the aircraft crew to operate the Universal Cargo Hook compared with the standard cargo hook. Extra briefings and precautions were necessary to prevent inadvertent release of external loads because of the three additional release mechanisms.



